ALFA: A new Framework for ALICE and FAIR experiments

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Introduction

The FairRoot framework [1] started in 2003/2004 as a framework for CBM collaboration. Meanwhile it is used by 7 experiments as a base for their simulation and analysis: CBM, PANDA, R3B, ASYEOS and the GEM subgroup of FOPI at GSI/FAIR. The MPD experiment at JINR in Dubna and the EIC collaboration are also using the FairRoot framework as a base for their own software. The commonalities between ALICE and the FAIR experiments and their computing requirements lead to the expectation that large parts of the software framework can be written in an experiment independent way. The FairRoot project has already shown the feasibility of the approach of developing a common framework for several experiments. We therefore propose to develop the new common framework which will be called ALFA.

Technology background

The efficient use of a concurrent computing system requires the correct sequencing of the interactions or communications between different computational executions, as well as coordinating access to resources that are shared among executions. A number of different methods can be used to implement concurrent programs, such as implementing each computational execution as an operating system process, or implementing the computational processes as a set of threads within a single operating system process. The future framework has to support a heterogeneous and distributed computing system.

A message-based approach will allow us to run our software on all hardware platforms (from a laptop to an entire system with many thousands of cores and specialized hardware accelerators). An Open-source system such as ZeroMQ [2] and/or nanomsg [3] will be used as a lightweight messaging layer. What is today a single threaded application will be transformed into many small components running concurrently as independent processes (executing on the same node or distributed over the network) with some of them utilizing capabilities of specialized hardware (where available) and communicating by asynchronous messaging.

Proposed architecture

The proposed architecture will rely on a data-flow based model. It will contain a common transport layer. Common configuration, management and monitoring tools will be developed. The framework will provide unified access to configuration parameters and databases. It will include support for a heterogeneous and distributed computing system. The proposed architecture will also incorporate common data processing components.

Expected benefits from the common project

This common development will benefit to all experiments involved; it will shorten the time to deliver production quality code and will reduce the cost to develop it. The work in common will also allow a better coverage and testing of the code. Moreover, the extended user community will provide high quality documentation, training and examples.

A common framework will be beneficial for the FAIR experiments since it will be tested with real data and existing detectors before the start of the FAIR facility. For example, concepts for online calibrations and alignment can be tested in a real environment, similar to that of the planned FAIR experiments.

ALICE will benefit from the work already performed by the FairRoot team concerning features (e.g. the continuous read-out), which are part of the ongoing FairRoot development.

Outlook

A proof of concept for the design and the technology has been successfully implemented [4]. Work on different prototypes is just starting; for ALICE and CBM the prototypes are planned for the end of this year. Both prototypes should show the ability of the ALFA framework to transport huge amount of data and distribute it on a large cluster of compute nodes. For PANDA experiment a prototype is also planned for this year which will concentrate on using heterogeneous architecture (CPU and GPU) for the online event reconstruction. Implementing these prototypes simultaneously will help us identifying more common issues and will enhance the synergy between the deferent experiments. Naturally all common packages will be implemented in the ALFA framework.

References

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